



Education/Public Outreach & Science Considerations for Data Visualization

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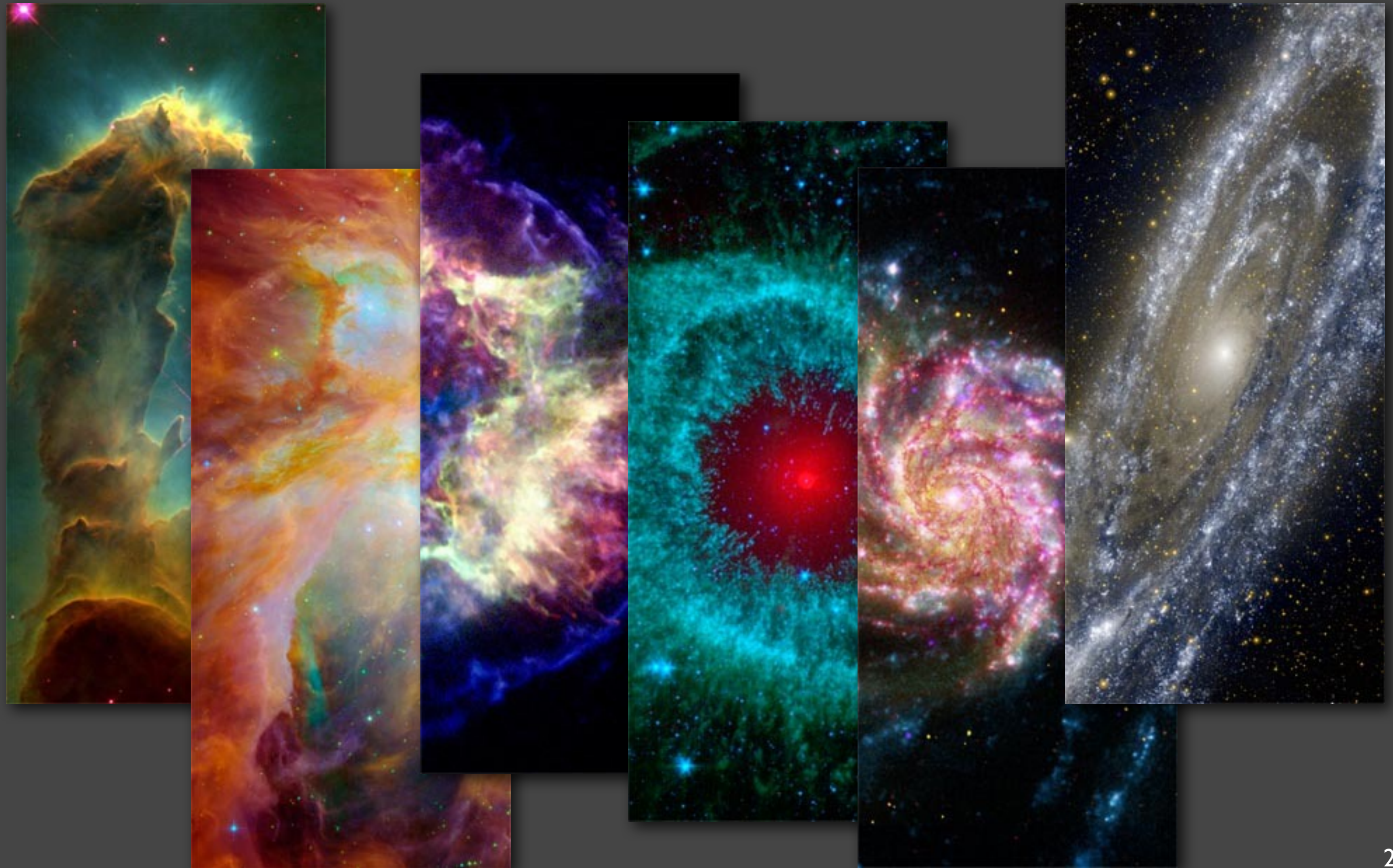
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Carolyn Brinkworth (IPAC/Caltech)



Images = NASA's Public Success





Some of NASA's Image Outreach Programs

- Astronomy Picture of the Day* (NASA)
- Hubble Heritage (STScI)
- AstroPix Archive* (Spitzer/IPAC)
- Space Images *website & iOS app* (JPL)
- Aesthetics & Astronomy* *research project* (Chandra)
- NASA Viz *iOS app* (GSFC)
- Zooniverse* Galaxy Zoo, Milky Way Project, etc.

* Projects inclusive of imagery beyond just NASA



Who Are Our Image Clients?

- Web-browsing public
- Amateur Astronomers
- Citizen Scientists
- Print, Web, Broadcast Media
- Educators & Students
- Science Centers & Planetariums
- 3rd Party Software (e.g. iPhone apps)

Research
can benefit
from all of
this too!



“You don’t have to be beautiful...
but it helps” –Pet Shop Boys

- Good visualization is a crucial SCIENCE issue
- Seeing is 1st step in understanding data
- Eyes are powerful processors of:
 - Patterns (groupings, structures)
 - Color (ratios, spatial trends)
- Tools to fine-tune an image benefit everyone
 - Aesthetic adjustments can also enhance science value
 - Current “research” viz tools are rudimentary



Massive Visualization Challenges: It Only Gets Harder!

- Multi-mission, multi-wavelength
- Wide-field and full-sky imaging
- High data volumes (terabyte, petabyte)
- Time domain data

Big Datasets (pixels, bytes)

- Software Needs

- Multi-wavelength datasets
- Visualizing time-domain
- Real-time interactive exploration
 - Pan/zoom
 - Dynamic contrast adjustment
 - Command line doesn't cut it!

- Hardware Needs

- HD = only 2 Megapixel!
- Tiled displays
- Immersive domes
- New interaction modes



Case Study: DS9

- Ubiquitous amongst astronomers
- Powerful handling of various datasets
 - Single channel
 - 3-color
 - Volume
- Basic user interface elements are 20+ years old
 - Poor algorithms for auto-display
 - Limited flexibility in dynamic range handling

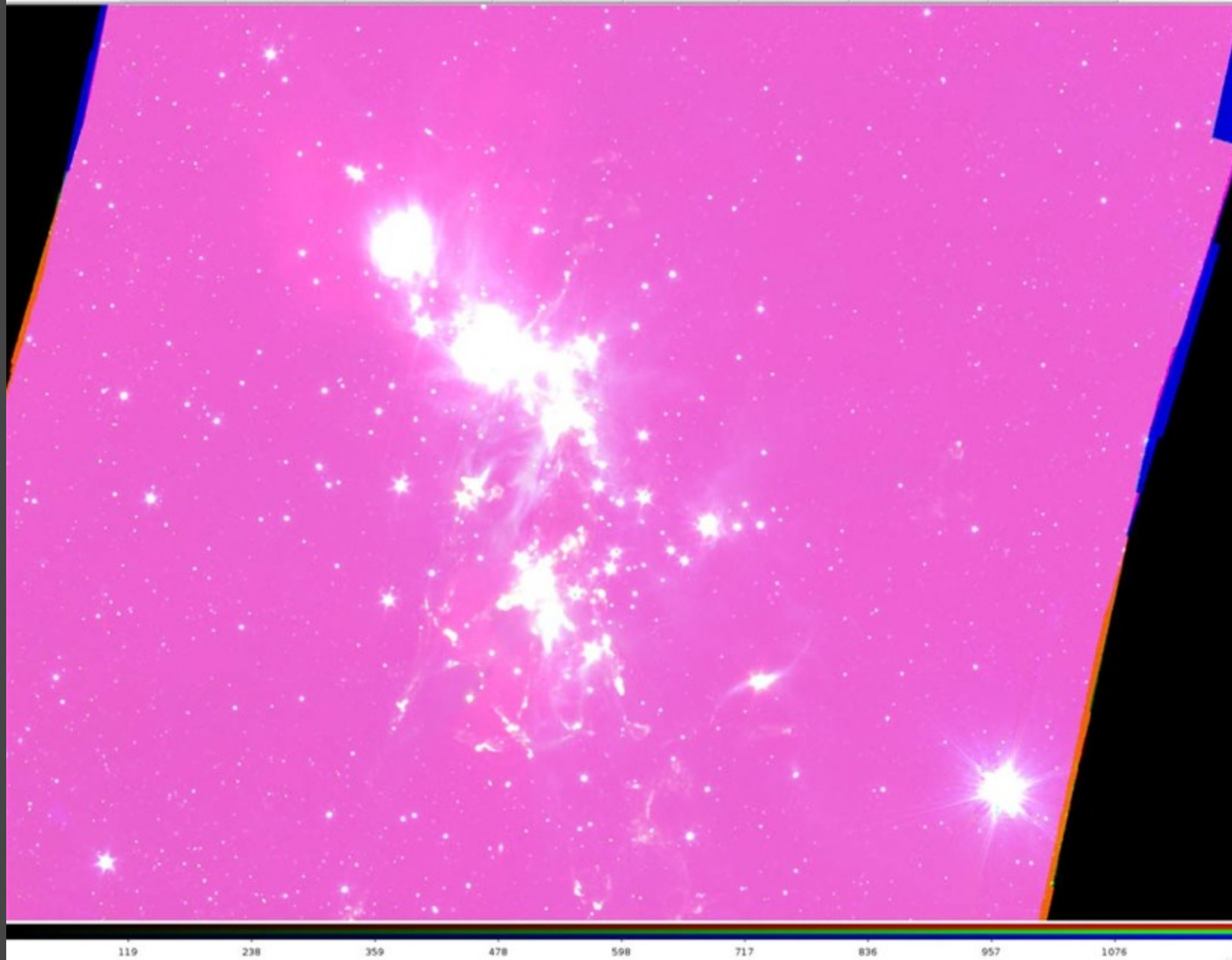
SAOImage ds9

File Edit View Frame Bin Zoom Scale Color Region WCS Analysis Help

File: ch4_mosaic.fits
Object: ngc1333

Value: r g b
WCS:
Physical: X Y
Image: X Y
Frame 2: x 1.000 0.000 *

file edit view frame bin zoom scale color region wcs help
linear log power square root squared asinh sinh histogram min max zscale



SAOImage ds9

File Edit View Frame Bin Zoom Scale Color Region WCS Analysis Help

File

ch1_mosaic.fits

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linear

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power

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histogram

min max

zscale





- The Tools
 - FITS Liberator app
 - Photoshop
- Greatly Improved Utility
 - Scientific
 - Aesthetic
- Could we ever see this kind of visualization by default?

Wide-Field Visualizations

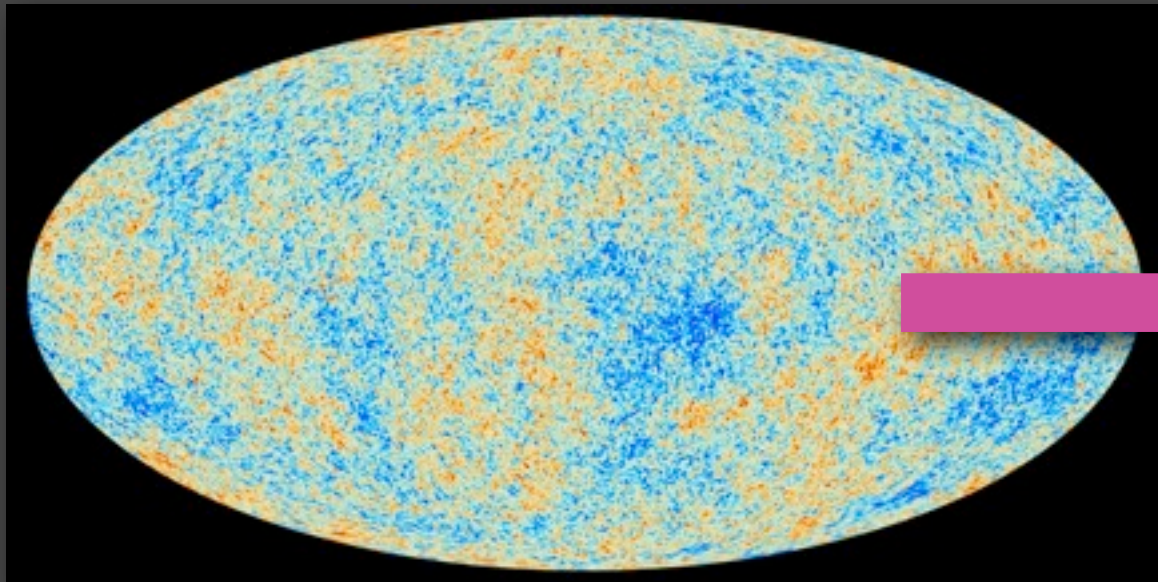


CAVE 2.0 @ University of Chicago

Rich collaboration opportunities between
astronomy missions & computer viz research &
science centers

Outreach & research go well together!

Case Study: Planck & Planetariums



Research data (healpix) and
media release image formats
not usable by planetariums

Mission data centers can
bridge the gap to provide
usable imagery

Case Study: Planck & Planetariums



The screenshot shows the IPAC Planck U.S. Data Center website. The header features the IPAC logo, the word "PLANCK" in large white letters, and "U.S. DATA CENTER AT IPAC" below it. A navigation bar includes links for "ABOUT", "NEWS", "GALLERY", and "FOR RESEARCHERS". On the right, there is a 3D cutaway illustration of the Planck satellite. The main content area is titled "Planetarium-Friendly Versions of Planck All-Sky Maps Available" and features two large spherical maps of the Cosmic Microwave Background. A sidebar on the left, titled "Related Media", lists four items: "Planetarium-Friendly Versions of Planck All-Sky Maps Available" (Feature), "Planck's Cosmic Microwave Background (CMB) Map" (Observation), "Planck's Cosmic Microwave Background Map (alt. color scheme)" (Observation), and "Planck's Map of Matter in the Universe" (Observation). Each item is accompanied by a small thumbnail image.

ipac

PLANCK

U.S. DATA CENTER AT IPAC

ABOUT | NEWS | GALLERY | FOR RESEARCHERS

Planetarium-Friendly Versions of Planck All-Sky Maps Available

Related Media

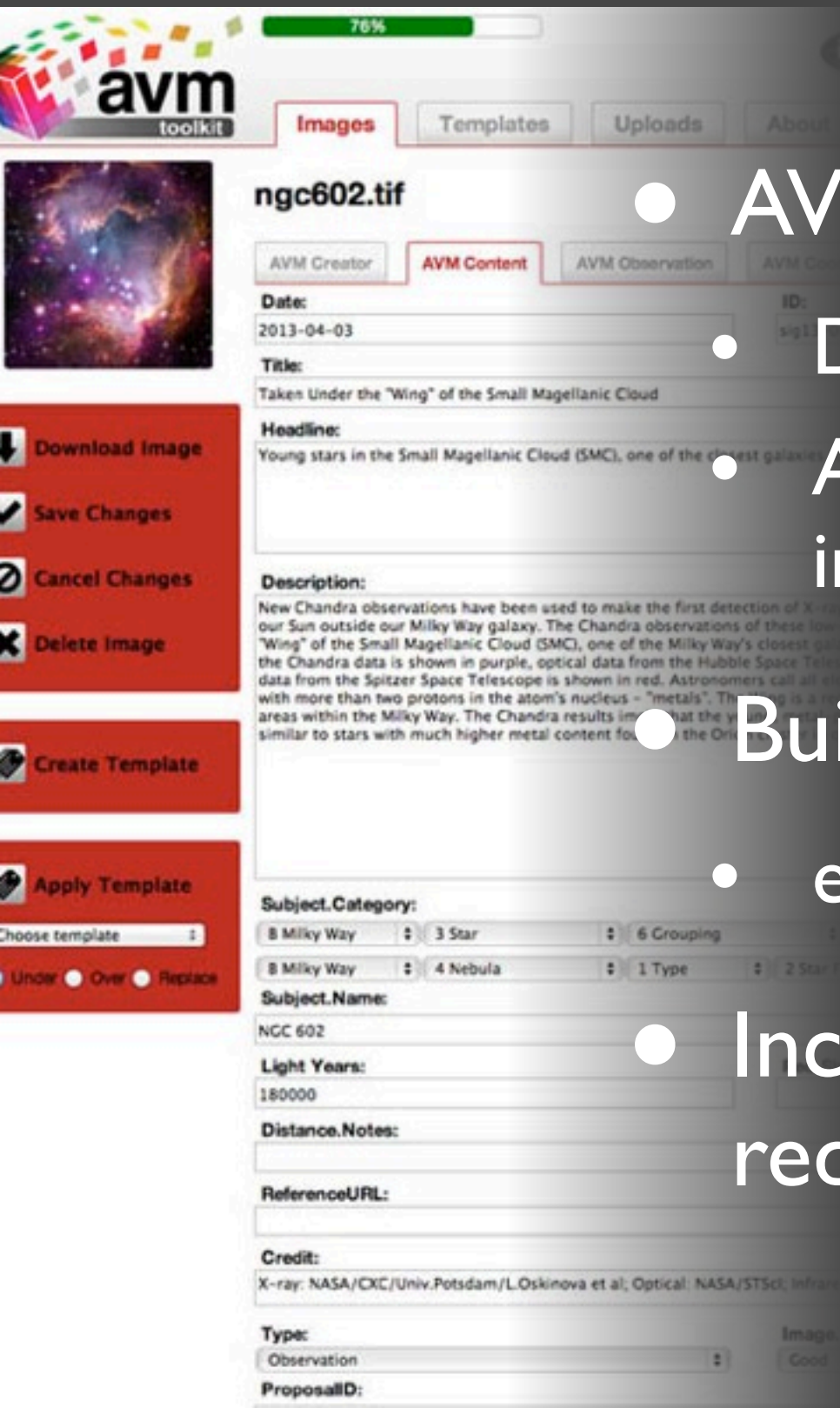
-  **Planetarium-Friendly Versions of Planck All-Sky Maps Available**
Feature
-  **Planck's Cosmic Microwave Background (CMB) Map**
Observation
-  **Planck's Cosmic Microwave Background Map (alt. color scheme)**
Observation
-  **Planck's Map of Matter in the Universe**
Observation



Maximizing Mission Image Quality

- Science & Public needs are not dissimilar
 - Science benefits from flexible, powerful viz
 - Public benefits from scientifically meaningful viz
 - Citizen science bridges both
- Most efficient to address these needs in tandem
- Missions know their own data best
 - Best visual presentations
 - Most relevant contextual/descriptive information
- Collaboration across missions for best practices

Case Study: Astronomy Visualization Metadata (AVM)



76%

avm toolkit

Images Templates Uploads About

ngc602.tif

AVM Creator AVM Content AVM Observation AVM Content

Date: 2013-04-03 ID: sig1

Title: Taken Under the "Wing" of the Small Magellanic Cloud

Headline: Young stars in the Small Magellanic Cloud (SMC), one of the closest galaxies to our Sun outside our Milky Way galaxy. The Chandra observations of these low-mass stars in the "Wing" of the Small Magellanic Cloud (SMC), one of the Milky Way's closest galaxies, is shown in purple, optical data from the Hubble Space Telescope is shown in red. Astronomers call all elements with more than two protons in the atom's nucleus - "metals". The Chandra results indicate that the young stars in the SMC are similar to stars with much higher metal content found in the Orion Nebula.

Description: New Chandra observations have been used to make the first detection of X-ray emission from our Sun outside our Milky Way galaxy. The Chandra observations of these low-mass stars in the "Wing" of the Small Magellanic Cloud (SMC), one of the Milky Way's closest galaxies, is shown in purple, optical data from the Hubble Space Telescope is shown in red. Astronomers call all elements with more than two protons in the atom's nucleus - "metals". The Chandra results indicate that the young stars in the SMC are similar to stars with much higher metal content found in the Orion Nebula.

Subject Category: 8 Milky Way 3 Star 6 Grouping

8 Milky Way 4 Nebula 1 Type 2 Star

Subject Name: NCC 602

Light Years: 180000

Distance Notes:

Reference URL:

Credit: X-ray: NASA/CXC/Univ.Potsdam/L.Oskinova et al; Optical: NASA/STScI; Infrared: NASA/Spitzer

Type: Observation Image

Proposal ID:

Download Image

Save Changes

Cancel Changes

Delete Image

Create Template

Apply Template

Choose template: 1

Under Over Replace

- AVM = FITS header for JPEGs, TIFFs
- Descriptive info (title, caption, source URL...)
- Astro info (coordinates, wavelengths, instrument...)
- Build into database-driven websites
- e.g. Spitzer website implements AVM
- Incorporate AVM directly into data reduction pipelines



Case Study: AVM & AstroPix

- AstroPix – Aggregator for AVM-tagged images
 - IPAC: Spitzer, WISE, NuSTAR, GALEX, etc.
 - STScI & ESA: Hubble
 - Chandra Science Center
 - European Southern Observatories
 - Soon: NOAO, NRAO, Lick, others
- Provides one-stop shopping for astronomy images
 - astropix.ipac.caltech.edu
 - Almost 3,000 images to date
- Enhanced experience enabled by common metadata format
 - Users of the website
 - 3rd party developers using public APIs

Related searches: [m16 round](#) [m16 gun](#) [m16 vs ar15](#) [m16 crossed](#) [m16 vs m4](#) [m16 drawing](#)

Googling “M16”
does not yield
astrophysically
relevant results

Filter by Date

Past Year (1)

Custom

TO
Go

Filter by Type

Image (270)

Video (10)

Filter by Branch

Civilian (280)

Filter by Cocom

USNORTHCOM (280)

Filter by Country

United States (280)

Filter by State

District of Columbia (131)

Filter by Journalist

Courtesy (280)

Home » Search » Orion

Filtered by:

Unit: NASA X

Showing Results 1-10 of 280

Sorted By: Relevance | Date Taken | Date Published

f Like 0

t Tweet 0

+1 f p e + Share

The “new”
nasaimages.org



Orion

Courtesy Photo | NASA | Date: 03.05.2010

Orion crew module, launch abort system mockups mated at WSMR Using mock-up components, technicians at the U.S. Army's White Sands Missile Range in New Mexico recently practiced the stacking process



Orion Nebula

Courtesy Photo | NASA | Date: 12.28.2010

This magnificent image from NASA's Spitzer and Hubble Space Telescopes shows the Orion Nebula in an explosion of infrared, ultraviolet, and visible-light colors. It was 'painted' by hundreds of baby



The Orion Nebula

Courtesy Photo | NASA | Date: 12.08.2009

This spectacular color panorama of the center the Orion nebula is one of the largest pictures ever assembled from individual images taken with NASA's Hubble Space Telescope. The picture, seamlessly



Radiator Stall test for Orion

Courtesy Photo | NASA | Date: 09.11.2009

Radiator Stall test for Orion NASA Identifier: C-2007-2334



Radiator Stall test for Orion

Courtesy Photo | NASA | Date: 09.11.2009

Radiator Stall test for Orion NASA Identifier: C-2007-2327



Radiator Stall test for Orion

Courtesy Photo | NASA | Date: 09.11.2009

Radiator Stall test for Orion NASA Identifier: C-2007-2337

Astrophysics
intermixed with
photography

SEARCH:

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Most Recent | Highest Rated | Most Popular

Images » Detailed View

f Like

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0

+1 f Print Email + Share



Images: Orion Nebula

NASA RSS Subscribe To This Unit

Courtesy Photo

★★★★★ Login to Vote!



This magnificent image from NASA's Spitzer and Hubble Space Telescopes shows the Orion Nebula in an explosion of infrared, ultraviolet, and visible-light colors. It was 'painted' by hundreds of baby stars on a canvas of gas and dust, with intense ultraviolet light and strong stellar winds as brushes. At the heart of the nebula, in the brightest part of the image, is a group of four monstrously massive stars, collectively called the Trapezium. Located 1,500 light-years from Earth, the Orion Nebula is the brightest point in the sword of the Hunter constellation. Image Credit: NASA

NASA Identifier: 440596main_STScI-2006-01q

Date Taken:	12.28.2010
Date Posted:	10.19.2012 18:38
Photo ID:	761342
Resolution:	6000x6000
Size:	899.25 KB
Location:	WASHINGTON, DC, US

Images Tags

[nasa](#), [hubblespacetelescopecollection](#)

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OTHER AREAS

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- Operation Enduring Freedom
- Operation New Dawn
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- Photo of the Week
- DIMOC Video
- Media Presskit



Minimal contextual
information,
registration required
for download

Orion Nebula



November 7th, 2006

spitzer_ssc2006-21a1

Credit: NASA/JPL-Caltech/T. Megeath (University of Toledo) & M. Robberto (STScI)

NASA's Spitzer and Hubble Space Telescopes have teamed up to expose the chaos that baby stars are creating 1,500 light-years away in a cosmic cloud called the Orion Nebula.

This striking infrared and visible-light composite indicates that four monstrously massive stars at the center of the cloud may be the main culprits in the familiar Orion constellation. The stars are collectively called the "Trapezium." Their community can be identified as the yellow smudge near the center of the image.

Swirls of green in Hubble's ultraviolet and visible-light view reveal hydrogen and sulfur gas that have been heated and ionized by intense ultraviolet radiation from the Trapezium's stars. Meanwhile, Spitzer's infrared view exposes carbon-rich molecules called polycyclic aromatic hydrocarbons in the cloud. These organic molecules have been illuminated by the Trapezium's stars, and are shown in the composite as wisps of red and orange. On Earth, polycyclic aromatic hydrocarbons are found on burnt toast and in automobile exhaust.

Together, the telescopes expose the stars in Orion as a rainbow of dots sprinkled throughout the image. Orange-yellow dots revealed by Spitzer are actually infant stars deeply embedded in a cocoon of dust and gas. Hubble showed less embedded stars as blue spots.

View Options

[Fullscreen](#)

[View in WorldWide Telescope](#)

Download Options

320x320 (26.8 KB)
500x500 (44.4 KB)
1024x1024 (113.3 KB)
1280x1280 (154.4 KB)

1600x1600 (211.2 KB)
3000x3000 (511.2 KB)
6000x6000 (1011.2 KB)

Image Details

Image Type

Observation

Object Name

Orion Nebula · Messier 42 · M42 · NGC 1976

Subject - Milky Way

Nebula » Type » Star Formation

Distance



Position Details

Position (ICRS)

RA = 5h 35m 9.7s

DEC = -5° 24' 49.0"

Orientation

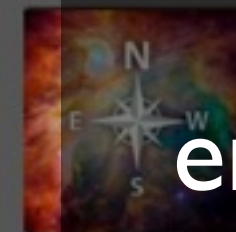
North is up

Field of View

30.0 x 30.0 arcminutes

Constellation

Orion



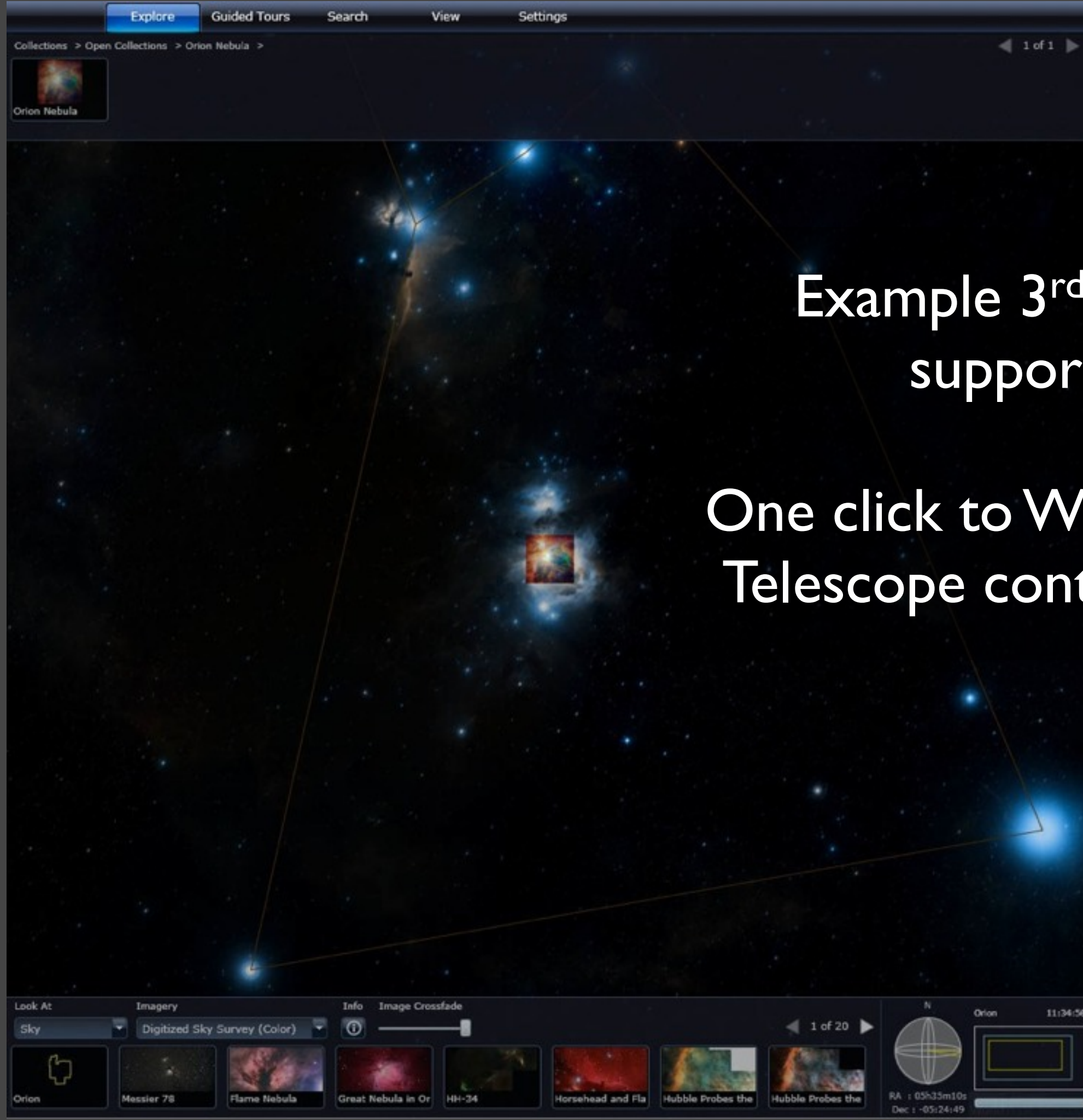
Color Mapping

Telescope	Spectral Band	Wavelength
Hubble (ACS)	Optical (B-band)	440.0 nm
Hubble (ACS)	Optical (V-band)	550.0 nm
Hubble (ACS)	Optical (H-alpha)	656.0 nm
Spitzer (IRAC)	Infrared (Near-IR)	3.6 μm
Spitzer (IRAC)	Infrared (Near-IR)	4.5 μm
Spitzer (IRAC)	Infrared (Mid-IR)	8.0 μm



Full description
Download options
Link to source URL
Distances
WCS
Color

EVERYTHING seen
on this page is
embedded within
the image!



Example 3rd party
support:

One click to WorldWide
Telescope context page

Our Problem:

Vastly increasing libraries of imagery, both hand-crafted (press releases) and automated (pipelines & archives)

Our Goal:

Find the images you need with the relevant contextual information attached

The Solution:

Metadata is a life preserver

Without it we will drown

Or at least, not be able to find anything



Considerations for Moving Forward

- Astronomy images are not photographs
 - Expertise needed to visualize effectively
- Missions know their data best
 - Best source of viz expertise is at the source
- Collaboration between missions necessary
 - Coherent standards, best practices, united vision
- Need next-generation tools for astro community
 - Smarter viz, expandable to handle gigapixel, terapixel datasets
 - Collaboration with museum/education community
- Metadata standards make images more useful
 - Research, planetariums, education, media, public